



# The Joker In The Silo

## Contactless radar level measurement for the most difficult of bulk solid applications

Until now, operators often had to accept compromises when undertaking continuous level measurement of bulk solids. Dust, filling noise, mechanical loads and difficult installation conditions aggravated the measuring process or even made it impossible. Since the arrival of a new radar for bulk solids – as the joker in the contest of measuring techniques, so to speak – these failings belong to the past.

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No question about it, level measurement in the world of bulk solids looks completely different from that in the world of liquids. The requirements placed on the measuring principle and the application are quite different. The vessel, the sensor installation environment, the process conditions as well as the characteristics of the measured product are important factors influencing the choice of measurement technology.

■ **Vessel:** There are many different types of vessels used for handling bulk solids. Large, tall and slender silos are typical. These are often segmented as well, which creates even narrower conditions in the vessel and has to be taken into account for level measurement. Bunkers, mounds and stockpiles, on the other hand, are rather broad, flat, voluminous and open. The vessel outlet – either flat or conical – as well as the roof construction also influence the level measurement. Depending on the measuring principle, considerable mechanical loads may act on a sensor mounted on the ceiling of the vessel.

■ **With regard to the installation conditions, a number of questions arise:**  
Is the sensor installed vertically from above, or laterally through the vessel wall?  
Are the correct distances strictly adhered to, i.e. the distance to the vessel wall, to filling and emptying apertures (the sensor should not be permanently exposed to the filling stream), to internal fixtures as well as to other gauges? Which mounting prerequisites can be taken for granted? That is, how big is the vessel opening and at what time can the sensor be installed? Does the vessel have to be empty for installation and can the sensor be installed at all in existing vessels (manhole available if necessary)? Do setup and commissioning require calibration with product?

■ **Process conditions:** Beside temperature and pressure, many factors in conjunction with the filling process have to be considered – material flow, dust generation and air turbulence as well as filling noise and the formation of material cones. During emptying, other factors may be important – the formation of material funnels and cornices as well as discontinuous product settling (e.g. sudden slipping).

■ **Product characteristics:** Grain size, shape and weight as well as the electrical properties (conductive or dielectric) of the bulk material also influence the selection of the measuring principle.

■ Composite influencing variables are: mechanical forces (tension and compression, shear stress, abrasion), electrical influences on the measuring principle and the measuring device, product deposits in the vessel and on the measuring device, and last but not least, safety guidelines (Dust Ex, Gas Ex).

The most common measuring principles for level measurement of bulk solids are: electromechanical (sounding), weighing, capacitive, guided microwave (TDR), laser as well as ultrasonic. The advantages and disadvantages of the different methods are compared in the table below. As you can see, the list of disadvantages isn't exactly short. Operators have learned over the years, however, to live with certain restrictions in bulk solid applications. If you would ask operators whether they are satisfied with their measuring technique, you would probably get a clear "yes" as an answer in nine out of ten cases.

But do they really have to live with those shortcomings? The level measurement experts at Vega Grieshaber in Schiltach are convinced of their answer: No!

## **The arrival of a new era**

An important measuring principle is missing in the above enumeration: radar measurement. In this field, Vega has been leading the way for many years in the area of liquid applications. With their new radar for bulk solids, Vegapuls 68, which came onto the market a year ago, the Black Forest experts have combined the advantages of radar measurement technology for liquids with the special prerequisites for bulk solid applications and optimized the processing algorithms accordingly. Originally intended to be "only" a consequent supplement to the existing line of products, the instrument surprised even its own creators at Vega – after the field experiences of the past year, it became apparent just how remarkable this achievement really was. Only when the dielectric constant of the bulk material is too low ( $< 1.4$ ) does the radar instrument have to call it quits. Just in time for this year's Interkama, where bulk solids radar will be an exposition highlight, Executive Director Günter Kech can declare, not without great pride: "With VEGAPULS 68 we have ushered in a new era in level measurement of bulk solids. Our vision of a universal measuring instrument has become reality with radar." So just what is so "revolutionary" about the new radar for bulk solids?

### *Pinpoint measurement*

The gauge delivers reliable filling levels even when exposed to high temperatures, and even extremely dusty surroundings don't bother it. A feature that stands out in comparison with previous radar devices is the very high dynamic range of over 100 dB. This allows signals to be evaluated that are 1000 times smaller than those processed by conventional radar instruments. This can be clarified with an example: If a person with a mass of 100 kg were weighed, scales with corresponding precision would register the loss of the weight of a single hair! Rainer Waltersbacher, director of product management and marketing at Vega, expounds on this: "It's exactly these performance reserves, gained through the high dynamic range, that allow us to still carry out reliable measurements under the most difficult conditions." The precision was achieved through (among other things) the use of highly sensitive, low-noise receivers which, due to their low inherent

noise, considerably amplify diminutive signals. Another innovation has to do with the electrical connection: a 2-wire version is available with which measurements up to 70 m can be carried out. This, for example, isn't possible with the ultrasonic principle – for bulk solids measurement, 4-wire instruments are always required.

### New antenna technology

Vegapuls 68 is available with two antenna versions:

- The familiar horn antenna was optimised for bulk solids – esp. with regard to its emission characteristics – and can even be mounted in small vessel sockets. It is extremely sensitive, especially at close range.
- The parabolic antenna is new – with a diameter of 250 mm, it boasts (acc. to Vega) a hitherto unachieved signal focusing performance. Because it is a separable antenna system, it can be mounted in very small process connections. Thanks to its recessed feed system, it is insensitive to fouling and damage and emits a steady signal unaffected by external factors. Both antenna systems are swivel-mounted to enable optimum alignment of the sensor. They also have a scavenging air connection for cleaning and cooling.

Separable antenna system  
Parabolic reflector  
Feed system



**Rainer Waltersbacher, product management and marketing director at Vega, explains the advantages of the parabolic antenna: A well-protected feed system is located at the focal point of the parabolic reflector. The microwave signal is radiated from it and focussed via the antenna surface (above).**

### **For further information:**

[www.process.de](http://www.process.de)

• Everything about the new bulk solids radar

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"Our vision of a universal measuring instrument has become reality with radar."

*Günter Kech, Managing Director*

*Vega Grieshaber*

## Measuring principle

### Electromechanical

**Advantages:** Independent of ceiling construction, vessel form, abrasive wear, grain size, filling noise, temperature

**Disadvantages:** Moving parts (wear), problems with dust and moisture (fouling and blocking), sensor weight can get buried or torn off, problems with air turbulence, mismeasurement due to air currents or feeler slippage, exclusively 4-wire technology

### Weighing

**Advantages:** Independent of the measured product, angle of repose, material flow, dust generation, filling noise, abrasive wear

**Disadvantages:** Costly planning and installation, retrofitting almost impossible, only possible in silos with truss construction, decoupling of inlet pipes required, setup with product, mismeasurement due to wind and snow loads as well as concentrated solar radiation

### Capacitive

**Advantages:** Independent of dust generation, filling noise, material flow, material cones, temperature, internal fixtures

**Disadvantages:** Setup with product, problems with abrasive wear, strong tractive forces (material weight i.e. product density, extraction forces, ceiling construction) and changing product characteristics (moisture content)

### Guided microwave (TDR)

**Advantages:** Setup without product

Independent of dust generation, filling noise, material flow, material cones, temperature, internal fixtures, product characteristics

**Disadvantages:** Problems with abrasive wear or strong tractive forces (material weight i.e. product density, extraction forces, ceiling construction); mounting guidelines must be observed: high mounting sockets cause interfering reflections, a reflector is required in vessels without a ceiling; microwaves are absorbed by nonconductive materials

### Laser

**Advantages:** Setup without product

Independent of abrasive wear, dielectric constant, product characteristics (moisture content, density), filling noise, air movement, temperature, narrow silos (focussed beam)

**Disadvantages:** Problems arise when the optical system is fouled, when dust is present (damping), or when the bulk material is in motion (light scattering)

## Ultrasonic

**Advantages:** Setup without product

Independent of abrasive wear, dielectric constant, product characteristics (moisture content, density)

**Disadvantages:** Interfering reflections from internal fixtures, reflection characteristics dependent on product (grain size, angle of repose, absorption)

Problems with air movement, filling stream, dust, filling noise, high temperature, pressure, steam, narrow silos (beam angle)

## Radar with Vegapuls 68

**Advantages:** Setup without product

Independent of abrasive wear, mechanical loads, product characteristics (moisture content, density), air movement, filling stream, dust, filling noise, temperature, pressure, vacuum, narrow silos (beam angle)

**Disadvantages:** Interfering reflections from internal fixtures, reflection characteristics dependent on product (grain size, angle of repose)